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Landforms
of the United States

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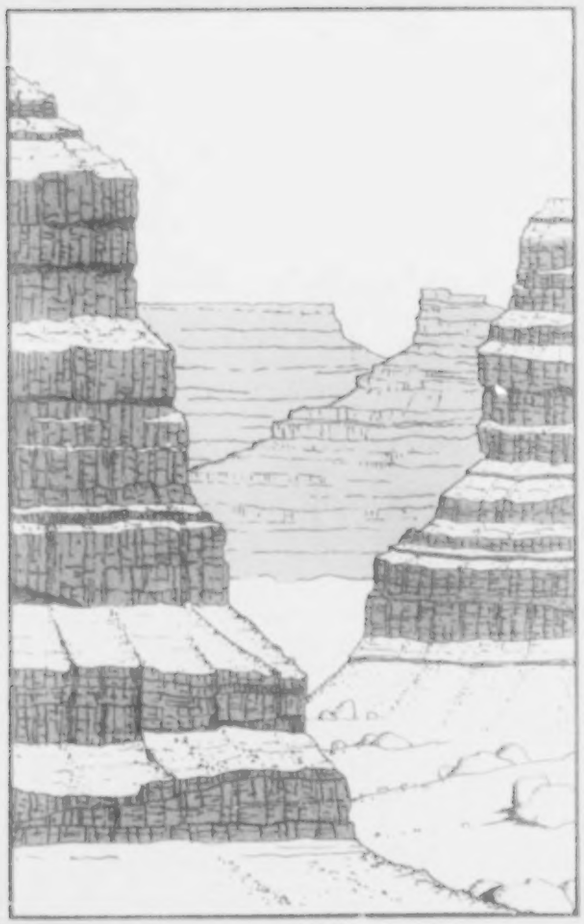

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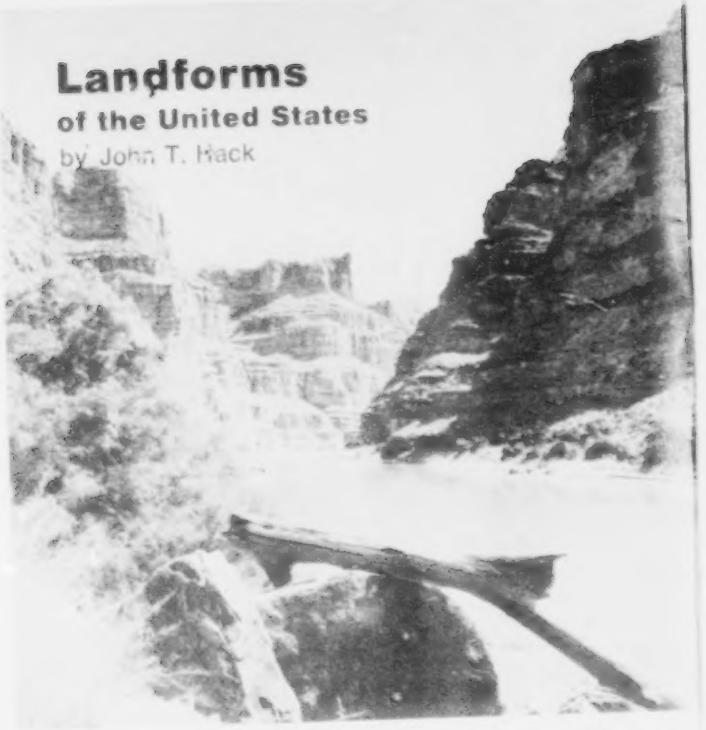
Landforms
of the United States

by John T. Hack



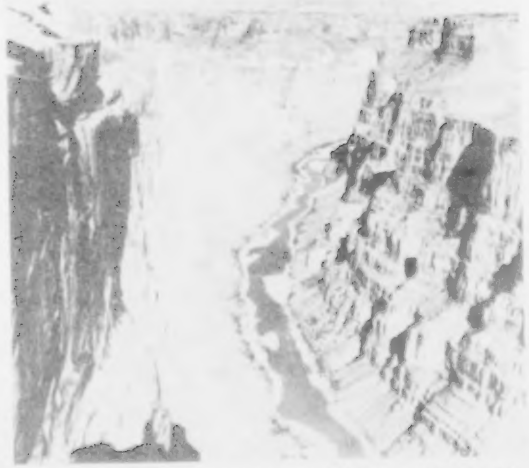
The United States contains a great variety of landforms which offer dramatic contrasts to a cross-country traveler. Mountains and desert areas, tropical jungles and areas of permanently frozen subsoil, and deep canyons and broad plains are examples of the Nation's varied surface. The present-day landforms—the features that make up the face of the Earth—are products of the slow sculpturing actions of streams and geologic processes that have been at work throughout the ages since the Earth's beginning.

Landforms may be classified as depositional or erosional. Depositional landforms have the character and shape of the deposits of which they are made. They include beaches, stream terraces, and alluvial fans at the foot of mountains. Erosional landforms are ones that have been created by agents of erosion such as streams, rain, and ice. The most widespread erosional landforms are those made by running water acting over very long periods of time.

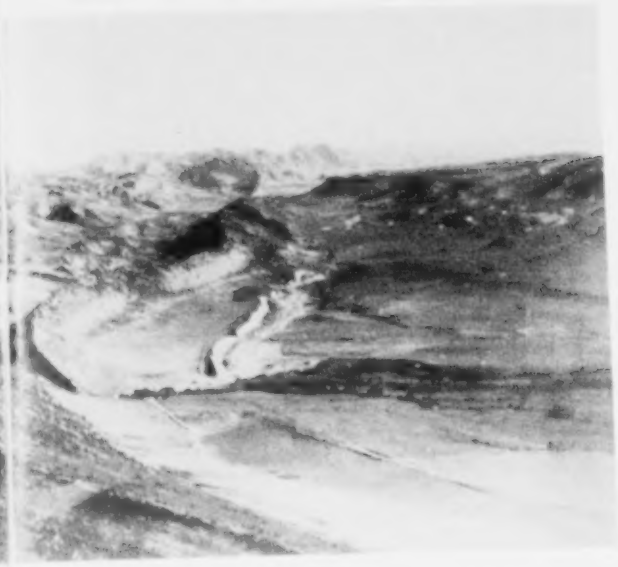
Rain, accumulating as a sheet of water on the ground, does not travel far before it gathers in channels. These channels, like branches of a tree, extend from a myriad of branchlets to larger and larger branches and finally to main trunk rivers. Stream channels are abundant in a humid climate, and commonly one cannot travel in a straight line for more than a half mile without encountering one. Stream channels also occur in deserts, but they are farther apart and water runs in them only intermittently.

This aerial view of stream-eroded landscape is in the Ozark Plateau, Missouri.

Long ridges mark the pattern of tilted layered rocks, Colorado.



Erosion of flat-lying layered rocks produces "stepped" slopes and plateaulike surfaces, Grand Canyon, Arizona.



Stream channels are the skeletal framework of the land surface. They are separated by an integrated pattern of ridges. The ridges are lowered, not by the streams, but by the creep of soil downhill or by erosion caused by thin sheets of water that have not yet gathered in stream channels. Streams and ridges together form a network of drainage basins. The ridges are higher in the mountain areas than in the lowland areas, but the overall patterns are similar. The ridges as well as the channels form an interconnecting treelike network. The trunk ridges form the main backbone of the area and rise to the greatest altitudes.

The variety in stream-eroded landscapes is produced partly by differences in the height to which the rocks have been uplifted above the surrounding area, but variations in rock types can also produce different kinds of landscapes. Rock types range from those that are massive, hard, and crystalline (such as granite) to those that are layered or stratified, consisting of thin to thick strata of varying strengths (such as shale or limestone). When running water erodes massive

Glacial drift is displayed below Dome Glacier, Alberta, Canada.

crystalline rocks, it produces a regular arrangement of hills and valleys in a succession of bowl-shaped drainage basins. If flat-lying rocks of various strengths are layered, the running water will produce "stepped" slopes and plateaulike surfaces. If the layered rocks are titled or folded, the resistant strata will be sculptured to form long ridges that mark the pattern of the folds.

Differences in landforms also result from differences in the length of time an area has been exposed to erosion. If the time is short, flowing water can carve only shallow valleys or none at all and, as water collects in the irregularities of the surface, swamps and lakes appear. An extended period of erosion will carve the land more deeply and will remove all vestiges of the original surface.

Glaciers are also effective agents of erosion. During the last several million years, large ice sheets moved down from Canada and covered the northern part of the United States. These ice sheets largely destroyed the typical stream-eroded landscapes. They rounded off ridges and mountains and enlarged some valleys. On the lowlands, the ice sheets left deposits of mixed sand, gravel, and clay that geologists call *glacial drift*. In places, great low ridges known as *moraines*

Kame Moraines are in the Finger Lakes region near Naples, New York.

were piled up at the forward edge of the ice. Some of these ridges in the Great Lakes region, though generally only about 100 feet high, are several miles wide and hundreds of miles long. They are commonly hilly and dotted with small lakes.

Geologists and geographers have subdivided the United States into areas called physiographic provinces, each of which has characteristic landforms. In the conterminous United States more than 80 such subdivisions are recognized, but for simplification they have been grouped together into 24 major provinces. This classification of landforms can be simplified still further by grouping the provinces into six large regions. The Continental Shelf, Alaska, and Hawaii are considered here as separate physiographic provinces.

Central Stable Region

Geologists consider the low central part of the continent the most stable part of North America. It consists of a core of ancient rocks that are the deeply eroded roots of mountains that may have been

formed 500 million to several billion years ago. This core area of the continent is known as the *Canadian Shield*, and the part that extends into the United States is called the Superior Upland. It is a hilly region, containing several rather rugged but low ranges which owe their height to the resistance of the rocks.

The Superior Upland is surrounded by extensive lowlands underlain by rocks that were deposited on the sea floor as sediments. These stratified rocks consist of limestone, shale, and sandstone arranged in broad domes and basins many miles across. Erosion has worn away the softer rocks to a level lower than that of the harder rocks. The beveled edges of single layers of rock can be traced in intricate patterns across the country.

Although the landscape is that of a typical stream-eroded region of low ridges and shallow valleys, it strongly reflects the differences in the rock on which it is carved. The more resistant rocks form long ridges or plateau margins (escarpments) such as the Knobstone Escarpment of Indiana and Kentucky or the Highland Rim of Tennessee. Some of the limestones form low plateaus underlain by caverns and sinks, such as the great cavernous belt that trends in a complex curving pattern from Alabama and Tennessee northeastward to include Mammoth Cave in Kentucky.

Appalachian Highland Region

The Appalachian Highlands border the Central Lowland on the east. They contain rocks of the same age, formed 200 to 1,000 million years ago, but the sediments from which the rocks of this region formed originally accumulated in a slowly sinking trough that attained depths of 6 or more miles. About 200 million years ago these rocks were uplifted and folded to form a complex mountain chain, now deeply eroded.

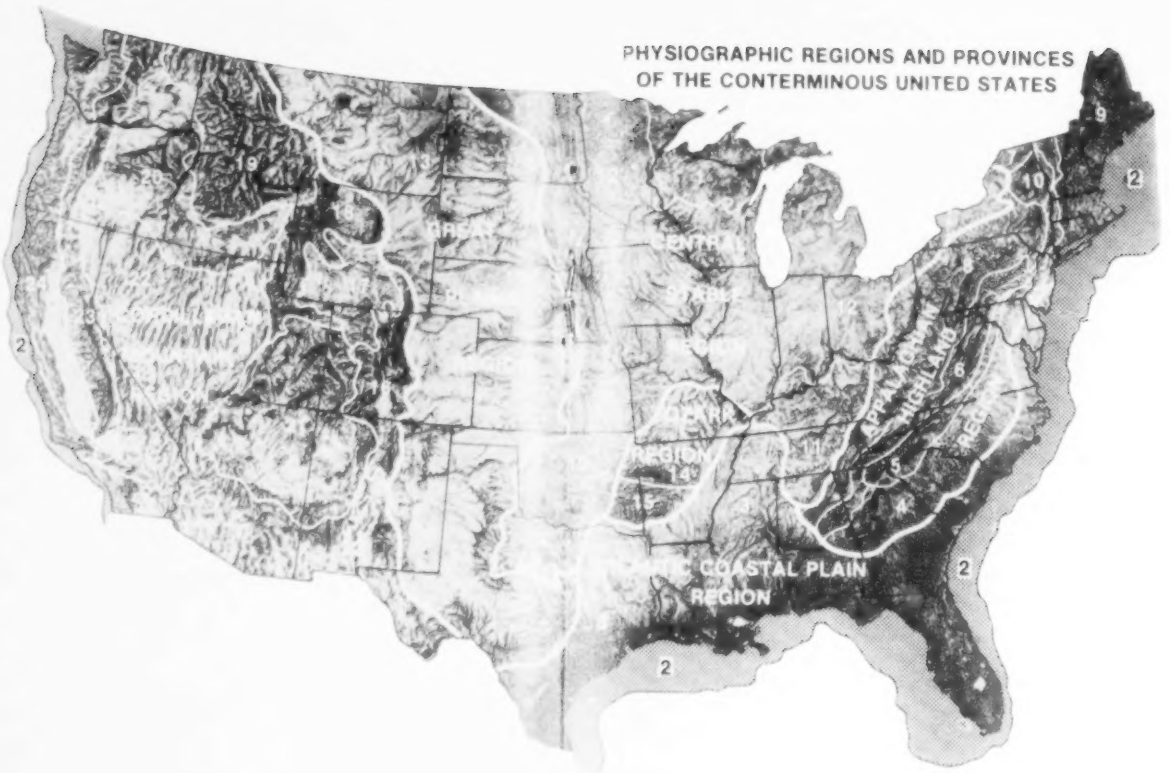
Mount Guyot, in the Great Smoky Mountains National Park, North Carolina/Tennessee, rises 6,621 feet above mean sea level.

The highest peaks (over 6,000 feet) are in the Blue Ridge Mountains of North Carolina and in the White Mountains of New England.

The Appalachian Highlands are not symmetrical. On the eastern border, an area of crystalline rocks called the Piedmont province rises gradually to the foot of the main ranges. The principal mountain ranges are a series of long ridges whose crests are underlain by upturned belts of resistant rocks that extend across the area in intricate patterns. On the northwest, the mountains are bordered by a wide belt of high plateaus. Most of the plateau tops are composed of standstone cut through by the major streams to form deep, canyonlike valleys.

Ozark Region

The Ozark Region is the western counterpart of the Appalachian Highlands. The region lacks an area corresponding to the Piedmont, but the Ouachita Mountains with ridges and valleys trending east and west are much like the Appalachians. The Ozark Plateaus are analogous to the Appalachian Plateau although they are not as high.



EXPLANATION

1. Superior Upland—Hilly area of erosional topography on ancient crystalline rocks.
2. Continental Shelf—Shallow sloping submarine plain of sedimentation.
3. Coastal Plain—Low, hilly to nearly flat terraced plains on soft sediments.
4. Piedmont Province—Gentle to rough, hilly terrain on belted crystalline rocks becoming more hilly toward mountains.
5. Blue Ridge Province—Mountains of crystalline rock 3,000 to 6,000 feet high, mostly rounded summits.
6. Valley and Ridge Province—Long mountain ridges and valleys eroded on strong and weak folded rock strata.
7. St. Lawrence Valley—Rolling lowland with local rock hills.
8. Appalachian Plateaus—Generally steep-sided plateaus on sandstone bedrock, 3,000 to 5,000 feet high on the east side, declining gradually to the west.
9. New England Province—Rolling hilly erosional topography on crystalline rocks in southeastern part to high mountainous country in central and northern parts.
10. Adirondack Province—Subdued mountains on ancient crystalline rock rising to over 5,000 feet.
11. Interior Low Plateaus—Low plateaus on stratified rocks.
12. Central Lowland—Mostly low rolling landscape and nearly level plains. Most of area covered by a veneer of glacial deposits, including ancient lake beds and hilly lake-dotted moraines.
13. Great Plains—Broad river plains and low plateaus on weak stratified sedimentary rocks. Rises toward Rocky Mountains, at some places to altitudes over 6,000 feet.
14. Ozark Plateaus—High, hilly landscape on stratified rocks.
15. Ouachita Province—Ridges and valleys eroded on upturned folded strata.
16. Southern Rocky Mountains—Complex mountains rising to over 14,000 feet.
17. Wyoming Basin—Elevated plains and plateaus on sedimentary strata.
18. Middle Rocky Mountains—Complex mountains with many intermontane basins and plains.
19. Northern Rocky Mountains—Rugged mountains with narrow intermontane basins.
20. Columbia Plateau—High rolling plateaus underlain by extensive lava flows; trenched by canyons.
21. Colorado Plateau—High plateaus on stratified rocks cut by deep canyons.
22. Basin and Range Province—mostly isolated ranges separated by wide desert plains. Many lakes, ancient lake beds, and alluvial fans.
23. Cascade-Sierra Nevada Mountains—Sierras in southern part are high mountains eroded from crystalline rocks. Cascades in northern part are high volcanic mountains.
24. Pacific Border Province—Mostly very young steep mountains; includes extensive river plains in California portion.

The Cordilleran Mountain Region

The Cordilleran Region is a wide mountainous belt that stretches from Central America northward to Alaska. Composed of a series of ranges, it occupies the western third of the United States. The Rocky Mountains extending from north-central New Mexico to Canada form the eastern edge of the region. These erosional features, carved by streams and glaciers, are the remnants of a complexly folded and uplifted segment of the Earth's crust that began to rise about 100 million years ago.

The Wyoming Basin forms a high gap across the middle of the Rocky Mountain chain where rocks of the Earth's crust have been only gently folded and not raised as high as the areas to the north and south. The Union Pacific Railroad takes advantage of this gap in crossing the Cordillera.

Two great high plateau areas—the Columbia Plateau and the Colorado Plateau—lie to the west of the Rockies. The Columbia Plateau is essentially a thick pile of ancient lava flows, trenched by canyons and deep valleys. The Colorado Plateau is an uplifted area displaying either gently folded or nearly horizontal rock layers sliced by streams, many of which are deeply entrenched in canyons, such as the Grand Canyon of the Colorado River.

The Basin and Range Province, centered principally on the State of Nevada but extending across the southern parts of Arizona and New Mexico, is a large area mostly occupied by desert plains interrupted by great north-trending mountain ranges formed from a series of tilted fault blocks. A large part of this area is known as the Great Basin because its drainage waters do not reach the sea but evaporate in saline lakes on the plains between the mountain ranges.

Part of the western Cordillera consists of two great north-trending mountain chains, the Sierra Nevada and Cascade Ranges. The Sierra Nevada Range, to the south, is an area of uplifted and tilted granite, much steeper on the east than on the west. Along its eastern margin the land rises abruptly from below sea level to heights greater than 14,000 feet, forming one of the most imposing

This telephoto view of the east front of the Sierra Range, taken from Owens Valley, shows part of the great escarpment nearly 2 miles in height. Inyo County, California

Mount Whitney, California, is the highest point in the conterminous 48 States.

escarpments in the United States. The highest peak of the range is Mount Whitney which, at 14,495 feet, is also the highest point in the conterminous United States.

The Cascade Range to the north is composed mostly of volcanic rocks and is crested by Mounts Baker, Rainier, Adams, Hood, Jefferson, and Shasta, and other extinct or dormant giant volcanoes.

The western edge of the Cordillera, as well as the western edge of the continent, is marked by a belt of roiling hills and mountains that form the Coast Ranges within the Pacific Border Province. Along the coast these mountains range in height from 2,000 to 4,000 feet.

Although now considered stable, parts of the Cordillera are still moving (especially the Sierra Nevada and Coast Ranges) as shown by continuing earthquake shocks. The most active area is the Coast Range of California where the rocks were uplifted above the sea less than 2 million years ago and where movement is continuing along great fractures (called faults) in the Earth's crust. The most famous of these is the San Andreas Fault zone which extends over 600 miles from

San Andreas Fault (between the arrows) is shown in this aerial photograph, Carrizo Plains, California.

north of San Francisco to the Gulf of California. Geologists believe that the major movement along this fault is horizontal and that the western side may have moved as much as several hundred miles in the last 70 million years.

In some places, such as the Cascade Mountains and the Colorado Plateau, volcanoes have been active within the last 2,000 years, and the original forms of many of them are well preserved. Escaping steam and hot water in areas such as Yellowstone Park indicate that in many places the underlying rocks are still hot at shallow depths.

Great Plains Region

The Great Plains Region is characterized by depositional rather than erosional landforms. It is a young landscape underlain by sediments that have been shed from the uplifted Rocky Mountains and deposited by streams during the last few million years. Some areas in the Great Plains preserve the original form of the stream deposits, but other areas have been uplifted and strongly etched by stream erosion and exhibit complicated landscape patterns. The land rises gradually from about 1,000 feet above sea level at the eastern margin to over

4,000 feet as it approaches the Rockies. In some places, as in southern Wyoming, the plains rise high enough to merge with the tops of the first ranges of the Rockies. Many areas have been covered by sediment in very recent times. In Nebraska a large area known as the Sand Hills has been covered by dune sands blown from the stream beds during the past million years. In a few places, the more ancient and hard rocks project through the sediments to form rugged erosional mountains, such as the Black Hills of South Dakota.

Atlantic Coastal Plain Region

The Atlantic Coastal Plain is the exposed margin of the Continental Shelf that has emerged from the sea during the past several million years. It is a lowland underlain by soft, unconsolidated marine sediments such as sand, silt, and clay. In a seaward direction, the topography gradually becomes flatter and lower and descends in a series of terraces. In some areas, as in southern Florida, the land is so flat that water collects on it in vast lakes and swamps. In other areas, particularly along the landward margin, the plain has been uplifted several hundred feet and eroded into hills and valleys cut by wide river plains.

The coastal plain along the Gulf of Mexico is considered to be part of the Atlantic Coastal Plain Region. Here the plain is a broad area of low relief that extends northward to the southern tip of Illinois and projects as a delta into the Gulf of Mexico. The delta and large areas of the plain along the Mississippi River were formed from the sand, gravel, and mud deposited by the river.

Alaska

Alaska is mostly an area of highlands that geologists consider to be part of the western Cordillera. The northern coast on the Arctic Ocean is bleak flat wasteland, close to sea level and dotted by many lakes and swamps. Bordering the northern coast is the Brooks Range, a folded mountain system rising to heights of 6,000 feet. South of these mountains are the plateau lands of the interior, drained by the Yukon River. Still farther south, the land rises to a group of young mountain ranges that border the Pacific Ocean. They include Mount McKinley, the highest point in North America at 20,320 feet

Mount McKinley, Alaska, 20,320 feet high, is the highest peak in North America.

Shishaldin Volcano towers 9,372 feet above mean sea level on Unimak Island in the Aleutian chain

above sea level, and the St. Elias Range, which has the largest ice field in North America. A chain of volcanoes, active and extinct, extends southwestward from the Alaskan Peninsula into the Pacific Ocean to form the bleak and rugged Aleutian Islands.

Much of Alaska, especially the interior, is a region of permafrost; that is, the ground is frozen all year round. During the summer only the upper few feet thaw. This condition poses unique engineering problems in the construction of roads and buildings because large areas of ground, when thawed, become swampy and unstable.

Hawaii

The Hawaiian Islands rise above the ocean floor in the central Pacific and extend more than 1,500 miles in a northwest-trending arc. The islands are of volcanic origin, formed by the outpouring of lava from a zone of fissures on the ocean bottom. Although the highest peak, Mauna Loa on the island of Hawaii, is only 10 miles wide, it rises 14,000 feet above the sea. Because of the moisture-laden trade winds that blow almost constantly from the northeast, the Hawaiian Islands have tropical jungles on their northeast coasts. The southwest sides tend to be arid.

Continental Shelf

The North American Continent rises above the ocean floor like a great platform with its coastal margins submerged beneath the sea. These submerged margins are collectively called the Continental Shelf. Off the east and gulf coasts, the shelf slopes gently into the water to a depth of about 100 fathoms (600 feet) and then descends sharply to the sea floor where it may be several miles deep. The shelf off the west coast is narrow, irregular, and, in places, broken by faults to form deep basins and troughs.

The Study of Landforms

The scientific classification and description of landforms in the United States and conclusions about how they came into being are among the basic studies conducted by the U.S. Geological Survey. Knowledge of landforms provides the foundation for other geologic investigations, including geologic history, engineering geology, geophysics, geochemistry, and hydrology. Landforms are indeed the keys to an understanding of the Earth.

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